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MulT_predict

A Multicomponent Geothermometer optimized by Sensitivity Analysis

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Motivation

- Create an economical green field exploration tool to precisely estimate reservoir temperatures from fluid composition
- Reduce input data to standard water analysis with no requirement for gas analysis
- Reconstruction of the chemical system on *in-situ* conditions to correct from secondary processes

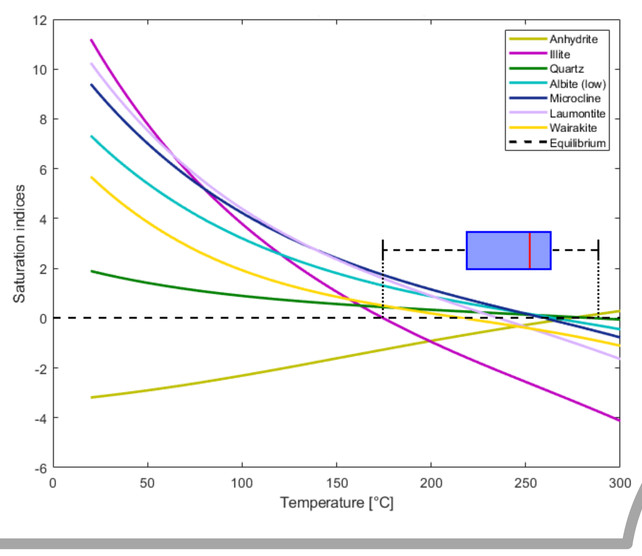
Conclusion

- **Increase of applicability**: Significant reduction of required input data (no gas analysis required)
- **Proof-of-concept**: Reconstruction of *in-situ* conditions based only on equilibria of reservoir minerals is valid
- **High accuracy**: Calculated temperatures match measured temperatures very well in validation cases

Multicomponent Geothermometry

- Basic assumption:
  - Reservoir mineral assemblage and the fluid are in chemical equilibrium
  - Reaction between host rock minerals and fluid is primarily temperature-dependent
- Input: Standard geochemical water analysis without sophisticated gas analysis
- Determination of *in-situ* temperature (equilibrium temperature distribution) based on the saturation state of reservoir mineral phases

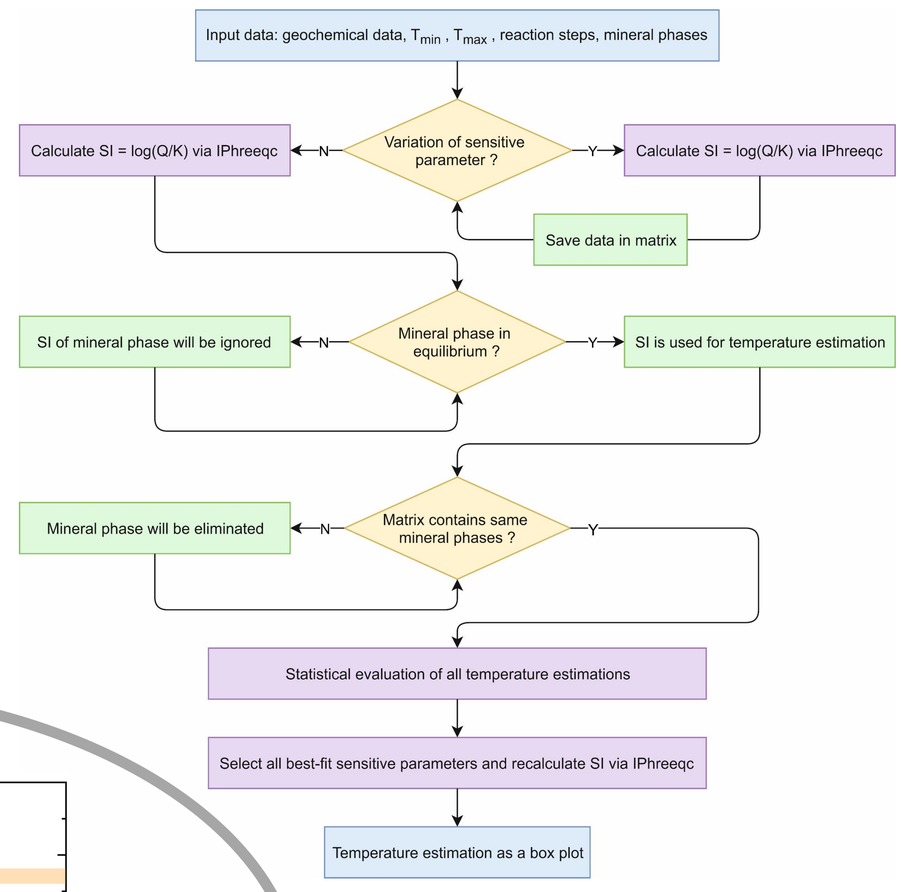
Equilibrium state of reservoir mineral assemblage



$$SI(T) = \log \frac{IAP}{K_s(T)}$$

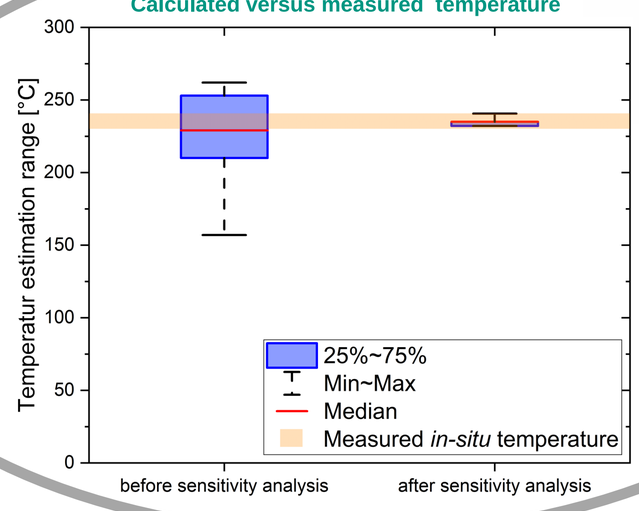
- Equilibrium state for SI = 0
- IAP: measured ion activity product
- K_S: mineral solubility product

Functionality of MulT_predict



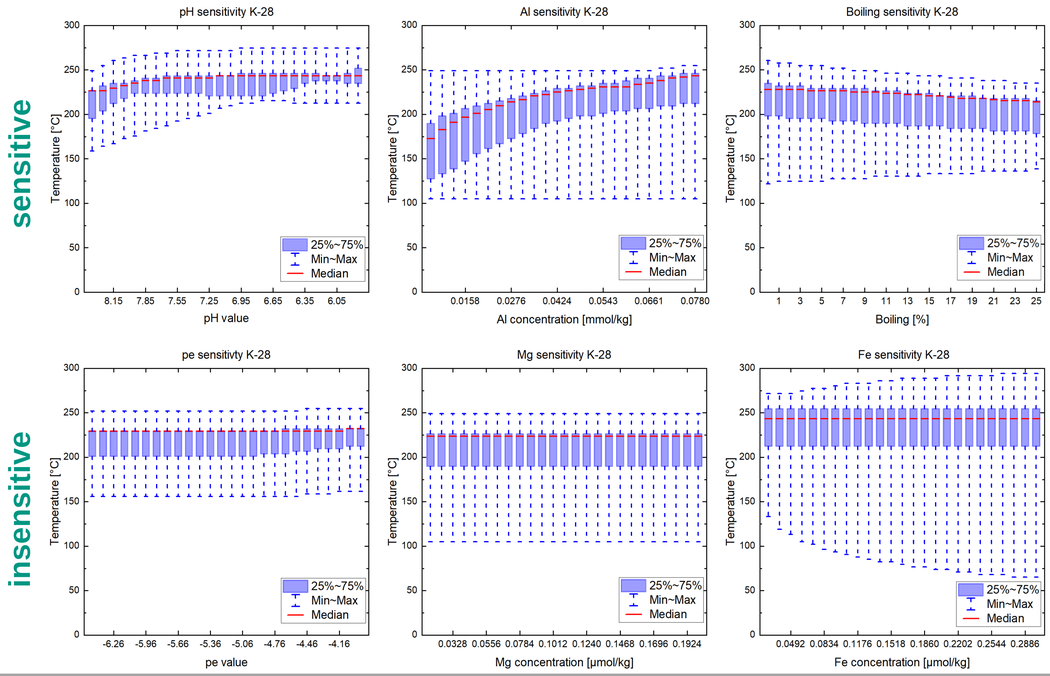
Tool Validation

Calculated versus measured temperature



Most Sensitive Parameters

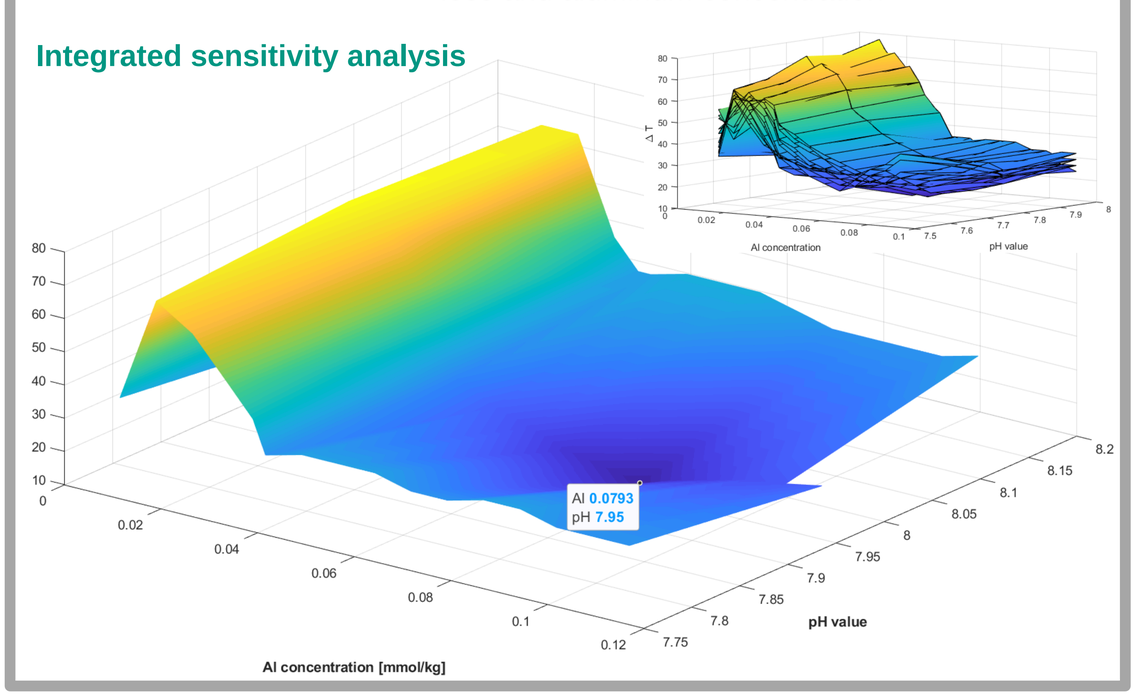
- Prime suspects:
  - System parameters (pH, redox, steam loss, dilution)
  - Fluid trace elements, which are main components of minerals (Al, Fe, Mg, etc…)



Sensitivity Matrix

- Minimization of equilibrium temperature distribution
- Simultaneous variation of measured values of sensitive geochemical parameters: pH, steam loss and aluminum concentration

Integrated sensitivity analysis



Publication of major contribution

Nitschke, F.; Held, S.; Villalon, I.; Neumann, T.; Kohl, T. (2017): Assessment of performance and parameter sensitivity of multicomponent geothermometry applied to a medium enthalpy geothermal system. In: Geothermal Energy 5 (1)